August 2001

Department of Energy
Office of Science
Laboratory Technology Research Program

Proposals Chosen for FY 2001 Multi-Year Projects

Advanced Materials

Title:	Advanced Processing Techniques for Tailored Nanostructures in Rare-Earth Permanent Magnets
Laboratory:	Ames Laboratory
Principal Investigator:	Matthew Kramer
Industry Partner:	Magnequench International Research Triangle Park, NC
Amount of Award:	$750,000
Brief Summary:	The objective of this project is to provide a fundamental understanding of the compositional dependence of melt pool rheology and heat flow characteristics on rapidly solidified rare-earth magnet alloys. The project will also try to achieve microstructural control of the rapid solidification process to produce highly grain-oriented anisotropic magnets with energy products comparable to the best-sintered magnets. Improvements in processing will result in both enhanced magnetic properties and lower cost, allowing new technological applications of these materials and resulting in significant energy savings.

*****

Title:	Nanofabrication of Advanced Diamond Tools
Laboratory:	Lawrence Berkeley National Laboratory
Principal Investigator:	Othon Monteiro
Industry Partner:	General Technology Berkeley, CA

Amount of Award:	$641,000
Brief Summary:	The objective of this project is to develop diamond tools to be used in micro- and nano-machining operations using scanning/probe technology. The project will develop a manufacturing process, based on plasma assisted chemical vapor deposition on pre-fabricated molds, to produce reliable and reproducible diamond tools for the repair of lithographic masks in the semiconductor processing industry.

*****

Title:	Efficiency Improvement of Nitride-Based Solid State Light Emitting Materials
Laboratory:	Lawrence Berkeley National Laboratory
Principal Investigator:	Eicke Weber
Industry Partner:	Lumileds Lighting San Jose, CA
Amount of Award:	$375,000
Brief Summary:	This project will aim to understand the fundamental mechanism of radiative carrier recombination in group-III nitride thin films, emitting in the green, blue, and ultraviolet region. The project will determine the indium content and its atomic scale distribution, perform local measurements of the piezoelectric fields, and model the impact of the piezoelectric field and the indium distribution on the emission efficiency of devices. Applications of this project include the development of light-emitting diodes with higher brightness and internal efficiency.

*****

Title:	Fundamental Scientific Problems in Magnetic Recording		
Laboratory:	Oak Ridge National Laboratory		
Principal Investigator:	William Butler		
Industry Partners:	Seagate Minneapolis, MN	IBM San Jose, CA	Imago Madison, WI

Amount of Award:	$750,000
Brief Summary:	The objective of this project is to develop atom probe techniques and technology that will allow the designers of magnetic readers to obtain images of magnetic multilayers with atomic scale resolution. The ever-decreasing size of magnetic bits requires higher coercivity media to prevent thermal fluctuations from affecting the stored information. The results of this project could continue the rapid decrease in the cost of data storage which contributes significantly to the increased productivity of many industries.

*****

Title:	Low-Cost, High-Performance YBCO Conductors
Laboratory:	Oak Ridge National Laboratory
Principal Investigator:	Parans Paranthaman
Industry Partner:	American Superconductor Westborough, MA
Amount of Award:	$750,000
Brief Summary:	The objective of this project is to develop material science and technology necessary for YBCO Coated Conductors on biaxially textured, non-magnetic, high-strength substrates. The project will also attempt to develop both vacuum and non-vacuum processes to deposit compatible buffers at high rates. Solutions for critical roadblocks will be addressed to try to accelerate the development and commercialization of low-cost, YBCO high temperature superconducting wires.

*****

Title:	Alloy Design and Development of Cast Cr-W-V Ferritic Steels for Improved High-Temperature Strength for Power Generation Applications
Laboratory:	Oak Ridge National Laboratory
Principal Investigator:	R. L. Klueh
Industry Partner:	GE Power Systems Schenectady, NY

Amount of Award: $610,000

Brief Summary: The objective of this project is to design and develop new cast steels with microstructures and mechanical properties as good or better than the wrought 3-9%Cr, 2-3%W, 0.25%V ferritic steels developed at ORNL and better than comparable cast alloys commercially available. Modeling work will be combined with experimental production and evaluation of castings to streamline the adaptation of the new wrought steels to casting applications and to ensure an optimization of composition to meet the elevated-temperature property demands. The ultimate goal is to provide an improved casing or critical component material for higher efficiency steam turbine and gas turbine technology for electric power generation.

Intelligent Processing and Manufacturing Research

Title: Development of a High Duty-Factor, High-Brightness, All-Niobium, Superconducting RF Gun

Laboratory: Brookhaven National Laboratory

Principal Investigator: Triveni Srinivasan-Rao

Industry Partner: Advanced Energy Systems
Medford, NY

Amount of Award: $750,000

Brief Summary: The objective of this project is to design, build, and test an all niobium superconducting RF electron injector of high duty factor and brightness. The simplicity and compactness of the all niobium superconducting cavity would result in an efficient electron source with superior performance and unique capabilities. This laser-excited electron gun, producing a continuous train of short electron bunches, is an enabling technology with applications that benefit research in linear colliders, Free Electron Lasers, cellular biology, molecular science, and materials science.

*****

Title:	Thermal Design and Analysis Tools for Dense-Wavelength Division-Multiplexed Optical Networks
Laboratory:	Lawrence Berkeley National Laboratory
Principal Investigator:	James Triplett
Industry Partner:	Fiber Network Engineering Livermore, CA
Amount of Award:	$360,000
Brief Summary:	The objective of this project is to develop thermal analysis and modeling tools specifically designed for the photonics and optical-networks industries that would allow optimization over the full range of design parameters. This would enable designers to integrate optical subsystems with maximum overall performance through effective thermal management. A modular approach will be used to develop design and analysis software so that the resulting simulation tools can be easily adopted for different configurations and applications.

*****

Environmental and Biomedical Research

Title:	Synchrotron-Based Structural Studies of Hydroporphyrin Sensitizers for Photodynamic Therapy
Laboratory:	Brookhaven National Laboratory
Principal Investigator:	Kathleen Barkigia
Industry Partner:	Miravant Medical Technologies Santa Barbara, CA
Amount of Award:	$750,000
Brief Summary:	The objective of this project is to unambiguously establish the molecular structures of new classes of hydroporphyrin

photosensitizers that are under development as agents for photodynamic therapy. This is a minimally invasive technique that combines light, oxygen, and a photosensitizer to attack cancerous and other diseased cells and tissues. The project will determine the solid state, powder, amorphous, and solution structures of hydroporphyrin photosensitizers using microcystallography, powder diffraction, and x-ray absorption spectroscopy at the BNL National Synchrotron Light Source.

*****

Title: Atomistic Processes of Catalyst Degradation

Laboratory: Oak Ridge National Laboratory

Principal Investigator: Stephen Pennycook

Industry Partner: ALCOA
Pittsburgh, PA

Amount of Award: $375,000

Brief Summary: The objective of this project is to improve the understanding of the atomic processes that control diffusion and aggregation of catalyst, dopant, and support species – the processes involved in the degradation of industrial catalysts. This will bring new scientific insight into the atomic-level processes of surface and bulk diffusion, the nucleation of catalyst particles, the role of metal/support interactions, and the evolution of electronic structure with particle size and shape. The potential benefits of new highly stable catalyst supports are enormous since, by some estimates, catalysis impacts 30% of the gross national product. Even incremental improvements would have a large payoff.

*****

Title: Array-Based Photo-Acoustic Spectroscopy for Environmental Assays

Laboratory: Pacific Northwest National Laboratory

Principal Investigator: James Amonette

Industry Partner: Harvard Bioscience
Holliston, MA

Amount of Award: $650,000

Brief Summary: The objective of this project is to develop a new photo-acoustic spectrometer for analysis of plate-based sample arrays with at least 200-fold greater sensitivity than existing absorption-based plate readers while maintaining the analytical flexibility offered by absorption spectroscopy. The enhanced sensitivity, analytical flexibility, and low cost of the photo-acoustic technique are expected to have a significant impact on array-based, high-throughput analysis that could boost the cost efficiency of bioscientific, biomedical, and environmental analytical work.

*****

Title: Unified Particle Handling Systems for Multiplexed Environmental Biodetection and Diagnostics

Laboratory: Pacific Northwest National Laboratory

Principal Investigator: Darrell Chandler

Industry Partner: BD Biosciences
San Jose, CA

Amount of Award: $750,000

Brief Summary: The objective of this project is to develop a new flow cytometer that contains an integrated particle handling/sample preparation platform. The instrument will be designed and built for the manipulation and analysis of small (?10?) particles and microorganisms, with an emphasis on environmental samples, and multiplexed nucleic acid detection methods and applications. This project will have an impact on bio- and environmental-science where rapid, economical, in-field, and point-of-use detection of multiple microorganisms or gene sequences is critical.

*****